

CLAIMS

1 1. A method of manufacturing a semiconductor component comprising:

2 providing a substrate with a surface;

3 providing a layer comprised of undoped gallium arsenide over the surface of the substrate;

4 forming a gate contact over a first portion of the layer; and

5 removing a second portion of the layer to expose a portion of the surface of the substrate.

6 2. The method of claim 1 wherein:

7 providing the layer further comprises providing the layer with a thickness of approximately
8 three to twelve nanometers.

9 3. The method of claim 1 wherein:

10 providing the layer further comprises providing the layer with a thickness of approximately
11 six to nine nanometers.

12 4. The method of claim 1 wherein:

13 forming the gate contact further comprises exposing the second portion of the layer.

14 5. The method of claim 1 wherein:

15 removing the second portion of the layer exposes a portion of the substrate.

16 6. The method of claim 1 further comprising:

1 implanting source and drain regions into the substrate after removing the second portion
2 of the layer.

3 7. The method of claim 1 further comprising:

4 implanting source and drain regions into the substrate before removing the second portion
5 of the layer.

6 8. The method of claim 1 further comprising:

7 forming a spacer adjacent to the gate contact after removing the second portion of the
8 layer.

9 9. The method of claim 1 further comprising:

10 forming a spacer adjacent to the gate contact before removing the second portion of the
11 layer.

12 10. The method of claim 9 further comprising:

13 keeping a third portion of the layer underneath the spacer after removing the second
14 portion of the layer.

15 11. The method of claim 1 wherein:

16 providing the substrate further comprises providing a delta-doped, heteroepitaxial
17 semiconductor structure for the substrate.

12. The method of claim 1 wherein:

providing the substrate further comprises:

providing a support layer;

providing a buffer layer overlying the support layer;

providing a doping layer overlying the buffer layer;

providing a spacer layer overlying the doping layer;

providing a channel layer overlying the spacer layer; and

providing a barrier layer overlying the channel layer.

13. The method of claim 1 wherein:

forming the gate contact further comprises:

forming the gate contact on the layer.

14. The method of claim 1 further comprising:

implanting source and drain regions into the substrate;

annealing the source and drain regions after removing the second portion of the layer; and

forming source and drain contacts over the source and drain regions after removing the second portion of the layer.

15. The method of claim 1 wherein:

removing the second portion of the layer further comprises keeping the first portion of the layer underneath the gate contact; and

1 removing the second portion of the layer further comprises keeping the first portion of the
2 layer undoped.

3
4 16. A method of manufacturing a semiconductor component comprising:
5 providing a delta-doped, heteroepitaxial semiconductor substrate with a surface, the delta-
6 doped, heteroepitaxial semiconductor substrate comprising:
7 a support layer comprised of semi-insulating gallium arsenide;
8 a buffer layer comprised of undoped gallium arsenide overlying the support layer;
9 a doping layer delta-doped with silicon and overlying the buffer layer;
10 a spacer layer comprised of undoped gallium arsenide and overlying the doping
11 layer;
12 an channel layer comprised of indium gallium arsenide and overlying the spacer
13 layer; and
14 a barrier layer comprised of aluminum gallium arsenide and overlying the channel
15 layer, the barrier layer forming the surface for the delta-doped, heteroepitaxial semiconductor
16 substrate;
17 providing an undoped gallium arsenide capping layer having a thickness of approximately
18 three to twelve nanometers and overlying the surface of the delta-doped, heteroepitaxial
19 semiconductor substrate;
20 forming a gate contact over the undoped gallium arsenide capping layer, the gate contact
21 covering a first portion of the undoped gallium arsenide capping layer and absent over a second
portion of the undoped gallium arsenide capping layer;

1 removing the second portion of the undoped gallium arsenide capping layer after forming
2 the gate contact to expose a portion of the surface of the delta-doped, heteroepitaxial
3 semiconductor substrate;
4 forming a spacer adjacent to the gate contact;
5 forming source and drain regions in the delta-doped, heteroepitaxial semiconductor
6 substrate; and
7 forming source and drain contacts over the source and drain regions after removing the
8 second portion of the undoped gallium arsenide capping layer.

9 17. The method of claim 16 wherein:

10 forming the source and drain regions further comprises implanting the source and drain
11 regions into the delta-doped, heteroepitaxial semiconductor substrate after removing the second
12 portion of the undoped gallium arsenide capping layer; and

13 forming the spacer further comprises forming a multi-layered spacer adjacent to the gate
14 contact after removing the second portion of the undoped gallium arsenide capping layer.

15 18. The method of claim 16 further comprising:

16 forming the source and drain regions further comprises implanting source and drain
17 regions into the delta-doped, heteroepitaxial semiconductor substrate before removing the second
18 portion of the undoped gallium arsenide capping layer;

19 forming the spacer further comprises forming a multi-layered spacer adjacent to the gate
20 contact before removing the second portion of the undoped gallium arsenide capping layer; and

1 keeping a third portion of the undoped gallium arsenide capping layer underneath the
2 multi-layered spacer after removing the second portion of the undoped gallium arsenide capping
3 layer.

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~~19. The method of claim 16 wherein:~~

~~providing the undoped gallium arsenide capping layer further comprises providing the~~
6 undoped gallium arsenide capping layer with a thickness of approximately six to nine nanometers.

20. The method of claim 16 wherein:

providing the delta-doped, heteroepitaxial semiconductor substrate further comprises:

providing the buffer layer on the support layer and consisting essentially of gallium
arsenide;

providing the doping layer on the buffer layer and consisting essentially of silicon
and gallium arsenide;

providing the spacer layer on the doping layer and consisting essentially of gallium
arsenide;

providing the channel layer on the spacer layer and consisting essentially of indium
gallium arsenide; and

providing the barrier layer on the channel layer and consisting essentially of
aluminum gallium arsenide;

providing the undoped gallium arsenide capping layer further comprises:

providing the undoped gallium arsenide capping layer on the barrier layer;

forming the gate contact further comprises:

1 forming the gate contact on the first portion of the undoped gallium arsenide
2 capping layer; and

3 removing the second portion of the undoped gallium arsenide capping layer further
4 comprises:

5 removing the second portion of the undoped gallium arsenide capping layer to
6 expose a portion of the barrier layer.

7 21. The method of claim 20 further comprising:

8 annealing the source and drain regions after removing the second portion of the undoped
9 gallium arsenide capping layer,

10 wherein:

11 providing the undoped gallium arsenide capping layer further comprises providing
12 the undoped gallium arsenide capping layer with a thickness of approximately six to nine
13 nanometers.

14 22. A semiconductor component comprising:

15 a substrate with a surface;

16 a layer comprised of undoped gallium arsenide over a first portion of the surface of the
17 substrate; and

18 a gate contact over the layer,

19 wherein:

20 the layer is absent over a second portion of the substrate.

1 23. The semiconductor component of claim 22 wherein:

2 the layer has a thickness of approximately six to nine nanometers.

3 24. The semiconductor component of claim 22 wherein:

4 the layer has a thickness of approximately three to twelve nanometers; and

5 the substrate is a delta-doped, heteroepitaxial semiconductor substrate comprising:

6 a support layer comprised of semi-insulating gallium arsenide;

7 a buffer layer comprised of gallium arsenide overlying the support layer;

8 a doping layer delta-doped with silicon and overlying the buffer layer;

9 a spacer layer comprised of gallium arsenide and overlying the doping layer;

10 an channel layer comprised of indium gallium arsenide and overlying the spacer

11 layer; and

12 a barrier layer comprised of aluminum gallium arsenide and overlying the channel
13 layer, the barrier layer forming the surface for the delta-doped, heteroepitaxial semiconductor
14 substrate.

15 25. The semiconductor component of claim 24 further comprising:

16 source and drain regions in the substrate;

17 a multi-layered spacer adjacent to the gate contact; and

18 source and drain contacts overlying the source and drain regions.